

Nearly 1 out of every 5 heating, air-conditioning, and refrigeration mechanics and installers is a member of a union. The unions to which the greatest numbers of mechanics and installers belong are the Sheet Metal Workers' International Association and the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada.

Related Occupations

Heating, air-conditioning, and refrigeration mechanics and installers work with sheet metal and piping, and repair machinery, such as electrical motors, compressors, and burners. Other workers who have similar skills are boilermakers, electrical appliance servicers, electricians, sheet-metal workers and duct installers, and plumbers, pipefitters, and steamfitters.

Sources of Additional Information

For more information about employment and training opportunities in this trade, contact local vocational and technical schools; local heating, air-conditioning, and refrigeration contractors; a local of the unions previously mentioned; a local joint union-management apprenticeship committee; a local chapter of the Associated Builders and Contractors; or the nearest office of the State employment service or State apprenticeship agency.

For information on career opportunities, training, and technician certification, contact:

✦ Air Conditioning Contractors of America, 1712 New Hampshire Ave., NW., Washington, DC 20009.

For information on technician certification, contact:

✦ North American Technician Excellence (NATE), Suite 300, 8201 Greensboro Drive, McLean, VA 22102.

✦ Air Conditioning Contractors of America, 1712 New Hampshire Ave., NW., Washington, DC 20009.

For information on career opportunities and training, write to:

✦ Associated Builders and Contractors, 1300 North 17th St., Rosslyn, VA 22209.

✦ Refrigeration Service Engineers Society, 1666 Rand Rd., Des Plaines, IL 60016-3552.

✦ Home Builders Institute, National Association of Home Builders, 1090 Vermont Ave. NW., Suite 600, Washington, DC 20005.

✦ National Association of Plumbing-Heating-Cooling Contractors, 180 S. Washington St., P.O. Box 6808, Falls Church, VA 22046.

✦ Mechanical Contractors Association of America, 1385 Piccard Dr., Rockville, MD 20850-4329.

✦ Air Conditioning and Refrigeration Institute, 4301 North Fairfax Dr., Suite 425, Arlington, VA 22203.

Home Appliance and Power Tool Repairers

(O*NET 85711A, 85711B, 85944, and 85999A)

Significant Points

- Although employment of home appliance and power tool repairers is expected to grow slowly, opportunities should be good for skilled repairers.
- Many repairers are high school graduates who are trained on the job.
- Knowledge of basic electronics is becoming increasingly important.

Nature of the Work

If your washer, dryer, or refrigerator has ever broken, you know the importance of a dependable repair person. Home appliance and power tool repairers, often called service technicians, keep your home appliances working and help prevent unwanted breakdowns. Some repairers work specifically on small appliances such as microwaves and vacuum cleaners;

others specialize in major appliances such as refrigerators, dishwashers, washers, and dryers. Still others handle power tools or gas appliances.

Repairers visually inspect appliances or power tools and check for unusual noises, excessive vibration, fluid leaks, or loose parts to determine why they fail to operate properly. They use service manuals, troubleshooting guides, and experience to diagnose particularly difficult problems. They disassemble the appliance or tool to examine its internal parts for signs of wear or corrosion. Repairers follow wiring diagrams and use testing devices, such as ammeters, voltmeters, and wattmeters to check electrical systems for shorts and faulty connections.

After identifying problems, they replace or repair defective belts, motors, heating elements, switches, gears, or other items. They tighten, align, clean, and lubricate parts as necessary. Repairers use common hand tools, including screwdrivers, wrenches, files, and pliers, as well as soldering guns and special tools designed for particular appliances. When repairing appliances with electronic parts, they may replace circuit boards or other electronic components.

Many manufacturers incorporate "fuzzy logic" technology into their newer and more expensive appliances. Fuzzy logic technology involves sensors, or inputs, strategically placed inside an appliance to transmit information to an on-board computer. The computer processes this information and adjusts variables such as water and electricity, to optimize appliance performance and reduce wasted resources. Fuzzy logic uses 1 input; "neurofuzzy logic" uses up to 5 inputs; and "chaos logic" uses up to 10 inputs. Dishwashers, washers, and dryers commonly use neurofuzzy logic in their components.

When repairing refrigerators and window air-conditioners, repairers must use care to conserve, recover, and recycle chlorofluorocarbon (CFC) and hydrochlorofluorocarbon (HCFC) refrigerants used in their cooling systems as required by law. Repairers conserve the refrigerant by making sure there are no leaks in the system; they recover the refrigerant by venting it into proper cylinders; and they recycle the refrigerant for reuse with special filter-dryers.

Repairers who service gas appliances may check the heating unit and replace tubing, thermocouples, thermostats, valves, and indicator spindles. They also answer emergency calls for gas leaks. To install gas appliances, repairers may have to install pipes in a customer's home to connect the appliances to the gas line. They measure, lay out, cut, and thread pipe and connect it to a feeder line and to the appliance. They may have to saw holes in walls or floors and hang steel supports from beams or joists to hold gas pipes in place. Once the gas line is in place, they turn on the gas and check for leaks.

Repairers also answer customers' questions about the care and use of appliances. For example, they demonstrate how to load automatic



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washing machines, arrange dishes in dishwashers, or sharpen chain saws to maximize performance.

Repairers write up estimates of the cost of repairs for customers, keep records of parts used and hours worked, prepare bills, and collect payments. They also document the capture and disposal of refrigerants.

Working Conditions

Home appliance and power tool repairers who handle portable appliances usually work in repair shops that are generally quiet, well lighted, and adequately ventilated. Those who repair major appliances usually make service calls to customers' homes. They carry their tools and a number of commonly used parts with them in a truck or van for use on their service calls. A repairer may spend several hours a day driving to and from appointments and emergency calls. They may work in clean comfortable rooms such as kitchens, or in damp, dirty, or dusty areas of a home. Repairers sometimes work in cramped and uncomfortable positions when replacing parts in hard-to-reach areas of appliances.

Repairer jobs generally are not hazardous, but they must exercise care and follow safety precautions to avoid electrical shocks and injuries when lifting and moving large appliances. When repairing gas appliances and microwave ovens, they must be aware of the dangers of gas and radiation leaks.

Many home appliance and power tool repairers work a standard 40-hour week. Some repairers work early morning, evening, and weekend shifts. Many repairers remain on-call in case of emergency. Many repairers work overtime and weekend hours in the summer months, when they are in high demand to fix air-conditioners and refrigerators. Repairers of power tools such as saws and drills may also have to work overtime during spring and summer months when use of such tools increases and breakdowns are more frequent.

Home appliance and power tool repairers usually work with little or no direct supervision, a feature of the job that appeals to many people.

Employment

Home appliance and power tool repairers held nearly 51,000 jobs in 1998. More than 15 percent of repairers are self-employed. About one half of salaried repairers worked in retail establishments such as department stores, household appliance stores, and fuel dealers. Others worked for gas and electric utility companies, electrical repair shops, and wholesalers.

Almost every community in the country employs appliance and power tool repairers; a high concentration of jobs are found in more populated areas.

Training, Other Qualifications, and Advancement

Employers generally require a high school diploma for home appliance and power tool repairer jobs. Repairers of small appliances and tools commonly learn the trade on the job; repairers of large household appliances often receive their training in a formal trade school, community college, or directly from the appliance manufacturer. Mechanical aptitude is desirable, and those who work in customers' homes must be courteous and tactful.

Employers prefer to hire people with formal training in appliance repair and electronics. Many repairers complete 1- or 2-year formal training programs in appliance repair and related subjects in high schools, private vocational schools, and community colleges. Courses in basic electricity and electronics are becoming increasingly necessary as more manufacturers install circuit boards and other electronic control systems in home appliances.

Regardless of whether their basic skills are developed through formal training or on the job, trainees usually receive additional training from their employer and manufacturers. In shops that fix portable appliances, they work on a single type of appliance, such as a vacuum cleaner, until they master its repair. Then they move on to others, until they can repair all those handled by the shop. In companies that repair major appliances, beginners assist experienced repairers on service

visits. They may also study on their own. They learn to read schematic drawings, analyze problems, determine whether to repair or replace parts, and follow proper safety procedures. Up to 3 years of on-the-job training may be needed for a technician to become skilled in all aspects of repair.

Some appliance and power tool manufacturers and department store chains have formal training programs that include home study and shop classes, in which trainees work with demonstration appliances and other training equipment. Many repairers receive supplemental instruction through 2- or 3-week seminars conducted by appliance and power tool manufacturers. Experienced repairers also often attend training classes and study service manuals. Repairers authorized for warranty work by manufacturers are required to attend periodic training sessions.

The Environmental Protection Agency (EPA) has mandated that all repairers who buy or work with refrigerants must be certified in its proper handling; a technician must pass a written examination to become certified to buy and handle refrigerants. Exams are administered by organizations approved by the EPA, such as trade schools, unions, and employer associations. There are even EPA-approved take-home certification exams. Though no formal training is required for certification, many of these organizations offer training programs designed to prepare workers for the certification examination.

To protect consumers and recognize highly skilled home appliance and power tool repairers, the Association of Home Appliance Manufacturers has instituted the National Appliance Service Technician Certification Program (NASTeC). Together, manufacturers, schools, and field experts write questions that measure the skills of their trade. To become certified, technicians must pass a comprehensive examination testing their competence in the diagnosis, repair and maintenance of major home appliances. The examination is given on demand at locations throughout the country. While there has not previously been standardized certification, growing numbers of employers now encourage repairers to become certified.

The Professional Service Association (PSA) has a certification program with similar goals to the NASTeC program—to recognize skilled repairers. To become certified, technicians must pass an examination. The PSA certification is valid for 4 years, and for renewal the technician must complete at least 12 credit hours of instruction every year during the 4 years. If the technician fails to accumulate the 48 hours of instruction, they must retake the examination.

Repairers in large shops or service centers may be promoted to supervisor, assistant service manager, or service manager. A few repairers advance to managerial positions such as regional service manager or parts manager for appliance or tool manufacturers. Preference is given to those who demonstrate technical competence and show an ability to get along with coworkers and customers. Experienced repairers who have sufficient funds and knowledge of small business management may open their own repair shop.

Job Outlook

Employment of home appliance and power tool repairers is expected to increase slower than the average for all occupations through the year 2008. Prospects should continue to be good for well-trained repairers, particularly those with a strong background in electronics. The number of home appliances and power tools in use is expected to increase with growth in the number of households and businesses and the introduction of new and improved appliances and tools. However, employment growth will be constrained as the frequency of repairs is reduced by increased use of electronic parts such as solid-state circuitry, microprocessors, and sensing devices in appliances. Nevertheless, as appliance and power tool repairers retire or transfer to other occupations, additional job openings will arise.

The availability of manufacturer sponsored training programs could also limit employment growth. Manufacturers often make these programs available only to large equipment dealers, thereby discouraging repairers from becoming self-employed or working for small shops. Many self-employed repairers are forced to join larger shops so that they can stay abreast of developments in the industry.

Jobs are expected to be increasingly concentrated in larger companies as the number of smaller shops and family owned businesses declines. However, those repairers that maintain strong industry relationships may still go into business for themselves.

Employment is relatively steady because the demand for appliance repair services continues even during economic downturns. However, during economic slowdowns some repair shops may lay off repairers.

Earnings

Median annual earnings, including commission, of home appliance and power tool repairers were \$26,010 in 1998. The middle 50 percent earned between \$20,380 and \$34,790 a year. The lowest 10 percent earned less than \$15,730 and the highest 10 percent earned more than \$42,090 a year.

Earnings of home appliance and power tool repairers vary according to the skill level required to fix equipment, geographic location, and the type of equipment repaired. Because many repairers receive commission along with their salary, earnings increase along with the number of jobs a repairer can complete in a day.

Many larger dealers, manufacturers and service stores offer benefits such as health insurance coverage, sick leave, and retirement and pension programs. Some home appliance and power tool repairers belong to the International Brotherhood of Electrical Workers.

Related Occupations

Other workers who repair electrical and electronic equipment include heating, air-conditioning, and refrigeration mechanics; locksmiths; motorcycle, boat, and small-engine mechanics; office machine and cash register servicers; electronic home entertainment equipment repairers; and coin, vending, and amusement machine servicers and repairers.

Sources of Additional Information

For information about jobs in the home appliance and power tool repair field, contact local appliance repair shops, manufacturers, vocational trade schools, appliance dealers, and utility companies, or the local office of the State employment service.

For general information about the work of home appliance repairers, contact:

- ☛ Appliance Service News, P.O. Box 809, St. Charles, IL 60174.
- ☛ National Association of Service Dealers, 10 E. 22nd St., Suite 310, Lombard, IL 60148.
- ☛ United Servicers Association, Inc., P.O. Box 59707, Dallas, TX 75229.
- ☛ National Appliance Service Association, 9247 N. Meridian, Suite 216, Indianapolis, IN 46260.

For information on technician certification, as well as general information about the work of home appliance repairers, contact:

- ☛ National Appliance Service Technician Certification Program (NASTeC), 10 E. 22nd St., Suite 310, Lombard, IL 60148. Telephone (tollfree): 1-888-NASTeC1 (627-8321).

Internet: <http://www.nastecnet.org>

- ☛ Professional Service Association, 71 Columbia St., Cohoes, NY 12047.

Industrial Machinery Repairers

(O*NET 85112, 85113, 85116C, 85118, 85119A, 85119B, 85128A, and 85128B)

Significant Points

- Workers learn their trade through a 4-year apprenticeship program or informal on-the-job training supplemented by classroom instruction.
- While employment of industrial machinery repairers is projected to grow more slowly than average, applicants with broad skills in machine repair should have favorable job prospects.

Nature of the Work

When production workers encounter problems with the machines they operate, they call industrial machinery repairers. These workers, also called industrial machinery mechanics or maintenance machinists, maintain and repair machinery in a plant or factory. Their work is important not only because an idle machine will delay production, but also because a machine that is not properly repaired and maintained may damage the final product or injure the operator.

Maintenance mechanics must be able to detect and diagnose minor problems and correct them before they become major ones. For example, after hearing a vibration from a machine, the mechanic must decide whether it is due to worn belts, weak motor bearings, or some other problem. Computerized maintenance, vibration analysis techniques, and self-diagnostic systems are making this task easier. Self-diagnostic features on new industrial machinery can determine the cause of a malfunction and, in some cases, alert the mechanic to potential trouble spots before symptoms develop.

After diagnosing the problem, the mechanic disassembles the equipment and repairs or replaces the necessary parts. Once reassembled, the final step is to test the machine to ensure it is running smoothly. When repairing electronically controlled machinery, maintenance mechanics may work closely with electronic repairers or electricians who maintain the machine's electronic parts. However, industrial machinery repairers increasingly need electronic and computer skills to repair sophisticated equipment on their own. (Statements on electronic repairers, commercial and industrial equipment, as well as electricians, appear elsewhere in the *Handbook*.)

Although repairing machines is the most important job of industrial machinery repairers, they also perform preventive maintenance. This includes keeping machines and their parts well oiled, greased, and cleaned. Repairers regularly inspect machinery and check performance. For example, they adjust and calibrate automated manufacturing equipment such as industrial robots, and rebuild components of other industrial machinery. By keeping complete and up-to-date records, mechanics try to anticipate trouble and service equipment before factory production is interrupted.

A wide range of tools may be used when performing repairs or preventive maintenance. Repairers may use a screwdriver and wrench to adjust a motor, or a hoist to lift a printing press off the ground. When replacements for broken or defective parts are not readily available, or when a machine must be quickly returned to production, repairers may sketch a part that can be fabricated by the plant's machine shop. Repairers use catalogs to order replacement parts and often follow blueprints and engineering specifications to maintain and fix equipment.



Industrial machinery repairers maintain and repair machinery in plants or factories.